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LABORATORY INVESTIGATIONS OF ANTI-CORROSION PROPERTIES OF *GREASES CONTAMINATED WITH FUNGI*

by

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LABORATORY INVESTIGATIONS OF ANTI-CORROSION PROPERTIES OF GREASES CONTAMINATED WITH FUNGI

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Grease and oil used for long-term protection of metal articles from corrosion and to insure uninterrupted work of mechanisms, sometimes become corrosion-active after a short time; moreover, their external appearance and properties are markedly changed. One of the reasons for this may be the instability of greases to contamination by microorganisms (V. N. Podgubnyy et al, 1967*).

Almost no work has been carried out on the study of the microbiological contamination of greases. Meanwhile, there are very few greases and oils which are resistant to biological action. In order to prevent the oxidation of greases and oils by oxygen in the air, inhibitors are added to them - substances suppressing their oxidation. In sitting greases and oils, for example, watch oil, antiseptic additives are added, which suppress the development of microorganisms.

*Podgubnyy, V.N., Novikova, G.A., Toropova, Ye. G., Sukhova, R.A. 1967. Investigation of Biological Stability of Greases. Tr. min. Kh i GP. Anniversary Symposium, Moscow. (Transactions of the Moscow Institute of the National Economy im. G. V. Plekhanov)

The most correct evaluation of the stability of greasy materials may be given by testing carried out under production conditions. However, such testing requires too much time and is difficult to carry out; therefore one must make a conclusion about the stability of greases to the actions of microorganisms on the basis of laboratory research.

In the present work a laboratory method is proposed for determining the stability of greases to contamination by microorganisms with simultaneous testing of anticorrosion properties of the greases on metal plates.

Metal plates 5×5 cm in dimensions were covered with a layer of grease 2-4 mm thick and were placed in two desiccators under identical conditions. Distilled water was poured on the bottom of the desiccators; as the result of this 100% relative humidity of the air was created in them. The desiccators were placed in a thermostat with a temperature of 28-30°C. In one desiccator the surface of the grease was inoculated with an aqueous suspension of spores of a mixture of fungi (experiment). Grease on the plates which were placed in the other desiccator were not inocculated with fungi (control). A metal plate which was not protected by oil was placed in both desiccators.

Pure cultures of fungi which were recommended by the International Electrotechnical Commission in Geneva in 1954 for testing of tropic-resistant materials, were used as the test organisms. Moreover, fungi which we isolated from grease samples which were located for a long time on an open platform of the corrosion station in a rural district near Moscow, were used. The following twelve species of fungi were tested: Aspergillus niger, Paecilomices varioti, Paecilomices kerioti, Stachibotris atra, Penicillium brevi compactum, Chaetomium globosum, Fusarium, Cladosporium resinae, Penicillium sp. strains 3/C-5.1/C-2, 3/12, 1/9 (all strains of Penicillium sp. were isolated from greases), and also a mixture of all of these fungi.

The growth of fungi is evaluated according to a five-intensity system: 0-absence of growth of fungi on the surface of the grease, 1-up to 10% of the surface of the grease covered with fungi, 2-fungi covered 20-30%, 3-40-50%, 4-60-80% of the surface of the grease, 5-fungi completely covers the surface of the grease.

The anticorrosion properties and biological resistance of the following greases were tested.

PVK grease, hydrocarbon protective, consists of petrolatum, ceresin, mineral oil; contains 1% additives of MNI-7 (All-Union State Standard 10584-63), represents an oxidized ceresin.

GOI-54p grease, field-protecting, hydrocarbon, consists of MVP oil, high-melting ceresin; contains 1% additive of MNI-7.

US-2 grease, fatty lubricating grease, anti-friction, consists of mineral oil, thickened 11% calcium soap, cottonseed oil; contains up to 2% chemically bound water.

Results of testing of anticorrosion properties are presented in Table 1.

Table 1

Results of Testing of the Protective Properties of Grease Contaminated with a Mixture of Fungi on Metallic Plates

a) grease, b) after 30 days, c) after 80 days, d) after 160 days, e) after 240 days, f) control-corrosion of metal without contamination by fungi, g) experiment with contamination, h) growth of fungi, number, i) corrosion of metal, j) GOI-54t, k) PVK, l) US-2 (fatty lubricating grease, m) none, n) none, o) grease changed markedly, darkened, p) properties of grease changed, q) slight spotty corrosion, r) grease blackened markedly, brownish spots on surface, s) slight corrosion began, t) none, u) intense spotty corrosion developed.

A Смазка	B Через 30 дней: F	B: G – H	B: G – I	C Через 80 дней: F	C: G – H (рост грибов, балл)	C: G – I (коррозия металла)	D Через 160 дней: F	D: G – H	D: G – I	E Через 240 дней: F	E: G – H	E: G – I
J ГОИ-54п	Нет M	2,5	Нет M	Нет M	3,0	Нет M	Нет M	4,0, свойства смазки изменились P	Нет M	Нет M	4,0	[illegible] S
K ПВК	То же N	2,5	То же N	То же N	3,5	То же N	То же N	4,0	То же N	То же N	4,0	T
L УС-2 (жировой солидол)	»	0,5	»	»	3,5, смазка сильно изменилась, потемнела O	»	»	3,5	» Q	Небольшая точечная коррозия	R	[illegible] U

As can be seen from the table, even after 30 days a difference is noted between the control samples, not contaminated with the fungi, and the experimental one. Control metallic plates, not protected with grease, under conditions of our experiment usually were corroded after 30 days of testing. Grease on control metal plates, not contaminated with fungi, after 160 days of testing had not outwardly changed. In the greases contaminated with fungi, growth of fungus colonies were observed after 80 days (Fig. 1), but there was still no corrosion on the metal plates. After 240 days of testing the control plates, protected by greases, not contaminated by microorganisms, appeared different: the external appearance of GSI-54p and PVK greases had not changed and corrosion of the metal was not detected on the sheets under the grease; the fatty lubricating grease US-2 changed markedly, darkened and under the grease some corrosion of the metal appeared. On plates protected by greases, contaminated with fungi, growth of the fungi was observed; moreover, under grease GOI-54p slight corrosion appeared, and under grease US-2 pronounced corrosion of the metal was revealed.

GRAPHICS
NOT REPRODUCIBLE

a b

Figure 1. Surface of PVK grease on a metal plate after 80 days of testing.
Key: a- grease not contaminated with spores of a mixture of fungi;
b- grease contaminated with spores of a mixture of fungi.

It should be noted that although during testing for a period from 30 to 160 days enhancement of the growth of the fungi on the surface of the greases was observed, in the period from 160 to 240 days the growth of fungi was curtailed, and they began to die. Possibly, this is associated with a change in the composition of the grease as a result of an accumulation in it of products of the life processes of the fungi. On the surface of US-2 grease brown spots appeared, and it blackened.

Thus, GOI-54p, PVK and US-2 (fatty lubricating grease) greases are not stable to contamination by fungi. GOI-54p and US-2 greases decompose and lose their anticorrosion properties under the influence of products of the life processes of the fungi.

The method which we used for testing of the protective (anticorrosion) properties of the greases, contaminated with fungi, on metallic plates permits determination under conditions approximating operating conditions, the anticorrosion properties of the greases and their stability to contamination with microorganisms at the same time. The determination is carried out under strict conditions under the absence of any external sources of nitrogen and carbon for nourishment of the microorganisms. If under these conditions the greases are contaminated with fungi, it is important that the greases be used by the microorganisms as the sources of carbon and nitrogen (microorganisms can also obtain nitrogen in microdoses from air).

Testing of the stability of greases to contamination by microorganisms on metallic plates permits one to make a more correct conclusion on the biological resistance and changes of properties of grease materials, than does testing in Petri dishes and auger media. Greases which have undergone biological testing in auger media and recognized as stable, should be subjected to additional verification on metallic plates according to the method developed by our laboratory for a period of 160 days.

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The protective properties of various greases contaminated with fungi were tested on metal plates. Greased metal plates were inoculated with spores of a mixture of fungi and placed in a desiccator under conditions of 100% relative humidity at 28-30°. Control plates were not contaminated with spores. Growth of fungus colonies was observed after 80 days, but no corrosion was detected even after 160 days on either the experimental or control plates. After 240 days, corrosion was observed under certain greases. This method is recommended for testing the stability of greases to microorganisms in preference to the use of auger media in Petri dishes.

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